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International application number: PCT/US05/003388

International filing date: 02 February 2005 (02.02.2005)

Document type: Certified copy of priority document

Document details: Country/Office: US

Number: 60/545,976

Filing date: 19 February 2004 (19.02.2004)

Date of receipt at the International Bureau: 07 March 2005 (07.03.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)



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*February 25, 2005*

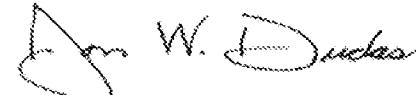
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APPLICATION NUMBER: 60/545,976

FILING DATE: *February 19, 2004*

RELATED PCT APPLICATION NUMBER: PCT/US05/03388

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Customer No. 31013

Docket No. 161485-00740

18351 U.S. PTO  
021904

17497 60/545976 US PTO  
021904

**PROVISIONAL APPLICATION FOR PATENT COVER SHEET**

Mail Stop Provisional Patent Application  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

This is a request for filing a Provisional Application for Patent under 37 C.F.R. § 1.53(c).

Inventor(s) and Residence (city and either state or foreign country):

Timothy Thomson - West Newbury, Massachusetts

For **ACTIVATED CARBON FILLED HYDROPHILIC FOAM AND PROCESS FOR THE MANUFACTURE THEREOF**

1.  15 sheets of specification
2.  A check in the amount of \$80.00 is enclosed in payment of the required fee. The Commissioner is hereby authorized to charge and additional fees or credit any overpayment to Deposit Account No. 50-0540.
3.  Please direct all communications relating to this application to the address of:

**Customer No. 31013**

4.  Applicant hereby states pursuant to 37 C.F.R. § 1.27(c)(1) that Applicant is a small entity.
5.  This invention was not made by an agency of the United States Government or under a contract with an agency of the United States Government.

Dated: February 19, 2004

Respectfully submitted,

By:   
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Reg. No. 22,802

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**Express Mail No: EL962387054US  
Date of Deposit: February 19, 2004**

**PROVISIONAL APPLICATION FOR LETTERS PATENT**

Inventor: Timothy Thomson

Title: **ACTIVATED CARBON FILLED HYDROPHILIC FOAM AND  
PROCESS FOR THE MANUFACTURE THEREOF**

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### Description of the Invention

We have developed a method for coating the surfaces of the pores of a substantially open-cell polyurethane foam. Activated carbon is exposed to a low molecular weight hydrocarbon gas (e.g. butane) and then slurried in a fluid, e.g. water. The slurry is emulsified with polyurethane prepolymer and deposited on the surfaces of the pores of a substantially open-cell polyurethane foam.

Methods for coating a polyurethane foam with hydrophilic polyurethane are taught in Thomson, US patent No. 6,617,014. While Thomson deals specifically with hydrophilic coated on hydrophobic foams, the method of this invention is also effective for coating hydrophobic prepolymers on polyurethane forms. Using either class of polyurethane, the composite foam is immediately exposed to live steam so that the emulsion is heated to a high temperature before it gels (cream time). The carbon-impregnated foam thus retains much of the activity of the untreated carbon.

We have discovered that the production of an effective carbon-impregnated foam can be achieved using the following steps. Immediately after emulsification of the prepolymer and the coreactant (polyol or water), the hydrocarbon that is absorbed into the carbon is vaporized and stripped out of the composition by the application of heat (steam or hot air). This opens up the pores of the carbon. The polymer then gels, permanently fixing the open pores produced by the outgassing.

### EXAMPLE 1

An activated carbon (NUCHAR RGC Powder, 879-R-02) was supplied by the Chemical Division of Westvaco, Covington, VA. It was pretreated by exposing 100 grams to 10 grams of butane gas. The carbon was shaken in a bottle to ensure complete absorption of the

butane. The carbon was slurried in 1 liter of tap water. One drop of dishwater soap was added to aid in the dispersion.

The slurry was transferred to the polyurethane composite production equipment for processing. A steam box was positioned immediately after the nip rollers. It was of sufficient size to ensure that the foam entering the box would have sufficient residence time to cure. Prior to the start of the run, steam was pumped through the box and the temperature checked to ensure it was ca, 100°C. (Figure 1)

Once the proper temperature was achieved, the Meter/Mix was started using an MDI-based prepolymer and an aqueous of 0.1% Pluronic L62. Standard operating procedures were followed throughout the run. Upon establishment of a controlled operation, the valving was changed to introduce the carbon slurry to the mix head. The run was continued until the carbon slurry was consumed.

The run was then terminated. The carbon-incorporated foam was dried at 105°C and bagged for subsequent analysis.

The amount of carbon was determined gravimetrically to be 29% by weight.

#### EXAMPLE 2

A 1 liter polyethylene bottle was used for the extraction studies. The bottle was filled with a small amount of butane (approximately 0.2 grams). The bottle was capped and a 2ml sample was withdrawn by inserting a syringe needle through the side. The sample was then injected into a gas chromatograph. The timer was started and a chromatogram recorded. Samples were taken over a period of 2 hours to ensure that the butane was not affected by the bottle itself (Figure 2).

A study sample was introduced into the bottle, capped, shaken for 10 seconds and a sample of the gas taken and analyzed as above. Evidence of extraction into the study sample is a decrease in the Butane peak height.

A plot of the butane peak height versus the reaction time was considered a measure of the kinetics of extraction. The data was fitted to an equation of the form:

$$C_{\text{butane}} = A(Rt)^{-B}$$

where:  $C_{\text{butane}}$  = the butane peak height

$A$  = the calculated intercept (a function of the initial concentration)

$Rt$  = residence time of the carbon in the bottle

$B$  is the slope of the line (the rate of extraction)

One gram of the Westvaco activated carbon was added to the bottle and the butane concentration was monitored. In Figure 3, we show the chromatograms and in Figure 4 we show a plot of the peak height versus reaction time with the equation which fits the curve to the data. It is clear from these data that the carbon is an effective extractor of butane under these conditions.

The procedure was then to introduce a foam sample into the newly charged and analyzed bottle of butane. Each foam sample was a 4.5" x 4.5" square of varying mass. All of the foam samples were pretreated in a 125°C oven for an hour.

The first foam sample was a material supplied by Crest Foam. It was reported to be a carbon impregnated reticulated foam manufactured by Lewcott Corporation. It was designated as Activfiler<sup>TM</sup> Media, CC-F 0.25-80ppi-100. The kinetics of extraction is reported in Figure 5.

Comparing the kinetics with the carbon data reveals that, relative to carbon, the Lewcott product has significantly lower activity. The slope of the carbon curve and the Lewcott curve (0.176 and 0.022, respectively) support this conclusion.

Other tests were conducted and they are presented here in Figures 6, 7 and 8.

Figure 9 shows the analysis of the effect of the carbon impregnated polyurethane composite as described in the production method described above. These data show that the polyurethane composite produced by the technique taught herein is significantly improved in effectiveness. In each of the following extractions, the polyurethane composite contained about 1.7 grams of carbon. The chromatogram in Figure 9 shows the ability of the composite to quickly reduce the butane concentration. It is a compilation of three separate extraction runs.

The kinetics of the extraction is reported in Figure 10.

In an effort to confirm this extraction effect, samples of polyurethane composite were produced with increasing amounts of carbon. The amount of carbon in each was not determined but the relative amounts were determined by comparing the reflectivity to visible light.

The kinetics of extraction are reported in Figure 11. The slope of the curves in Figure 12 show an exponential rise that is consistent with the increasing volume % of carbon. That increases the probability of carbon being at the surface of the polyurethane composite. A plot of the reflectance data (which is related to the carbon concentration) as a function of reflectivity is shown in Figure 13. The following table summarizes the data.

**Table 1: Summary of the Slopes of Curves Plotting  
the Kinetics of the Extraction**

Sample	Slope of the Curves
Westvac Carbon	0.176
Lewcott Media	0.022
Retculated Foam	0.025
Native CoFoam	0.038
CoFoamII	0.020
Polyurethane composite w/ 29% Carbon (0% Reflectance)	0.181
CoFoam (5% Reflectance)	0.069
CoFoam (12% Reflectance)	0.032
CoFoam (19% Reflectance)	0.038
CoFoam (30% Reflectance)	0.013

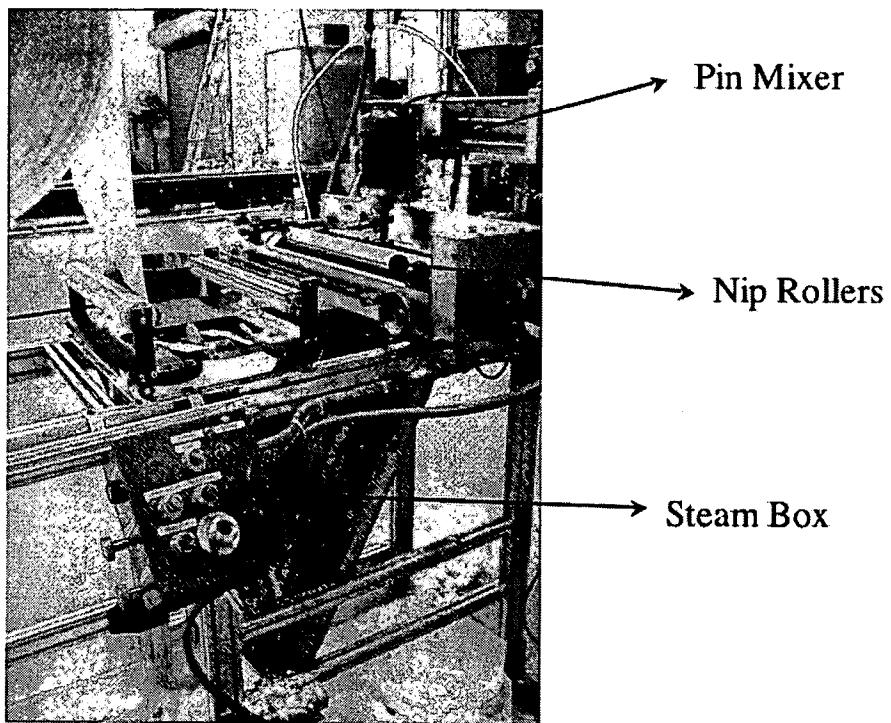


Figure 1: Process to Make Carbon-Impregnated CoFoam

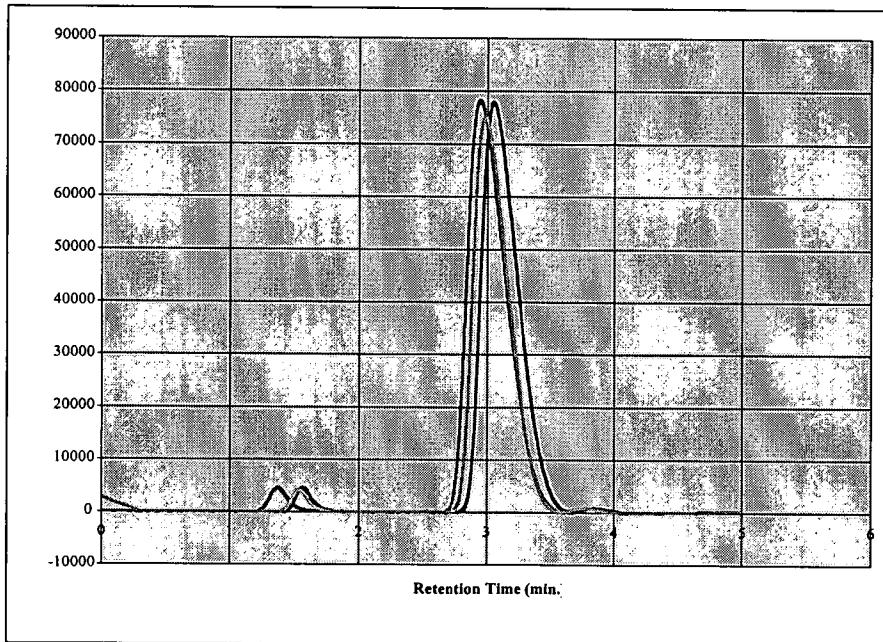


Figure 2: Concentration of Butane in a PE Bottle

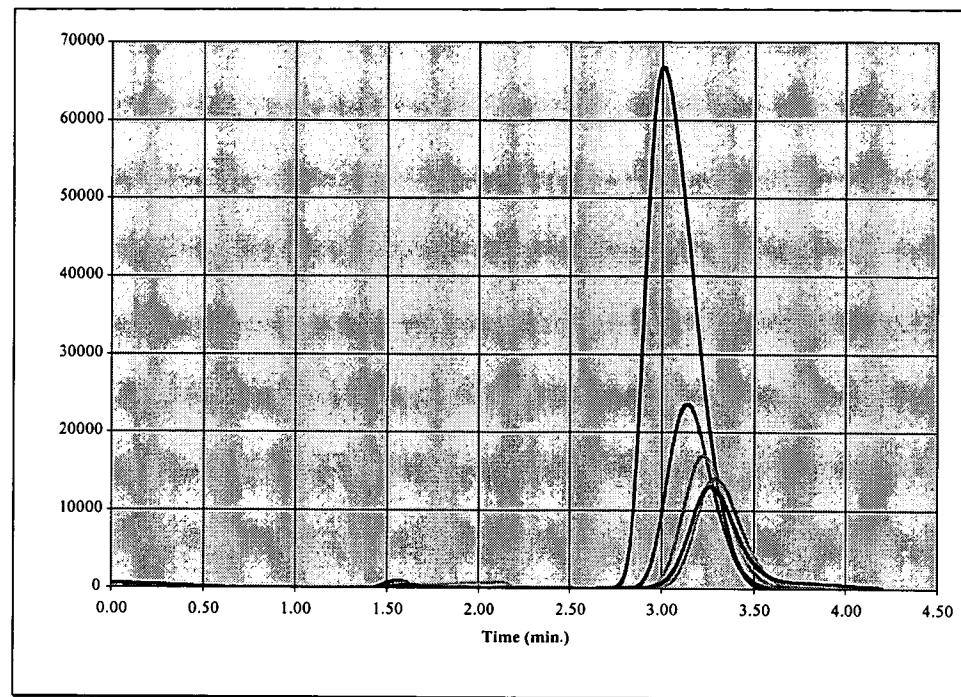


Figure 3: Extraction of Butane  
by Westvaco Carbon

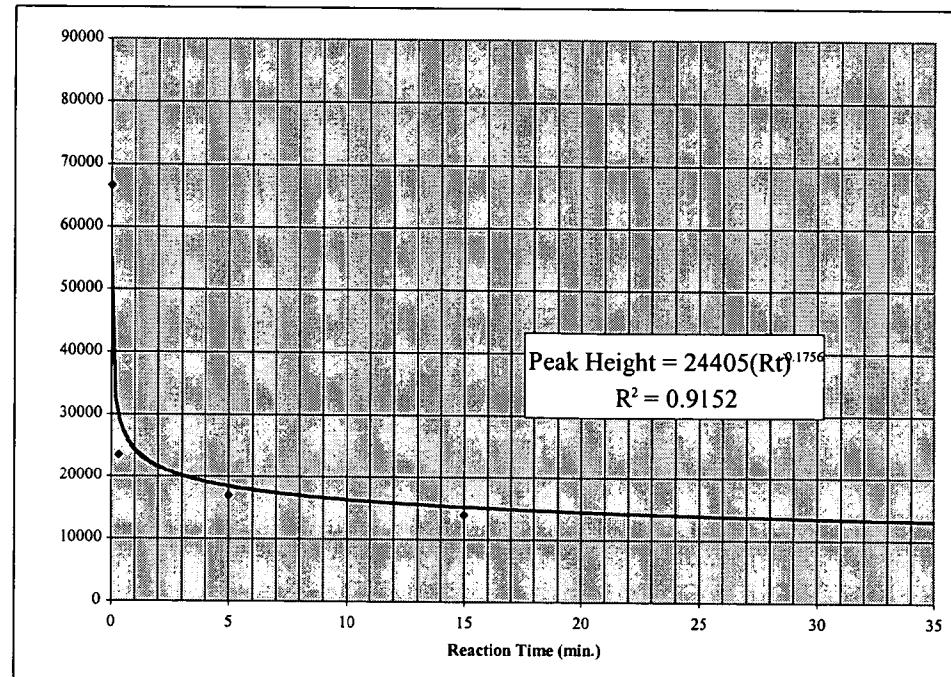


Figure 4: Kinetics of Extraction of  
Butane by Westvaco Carbon

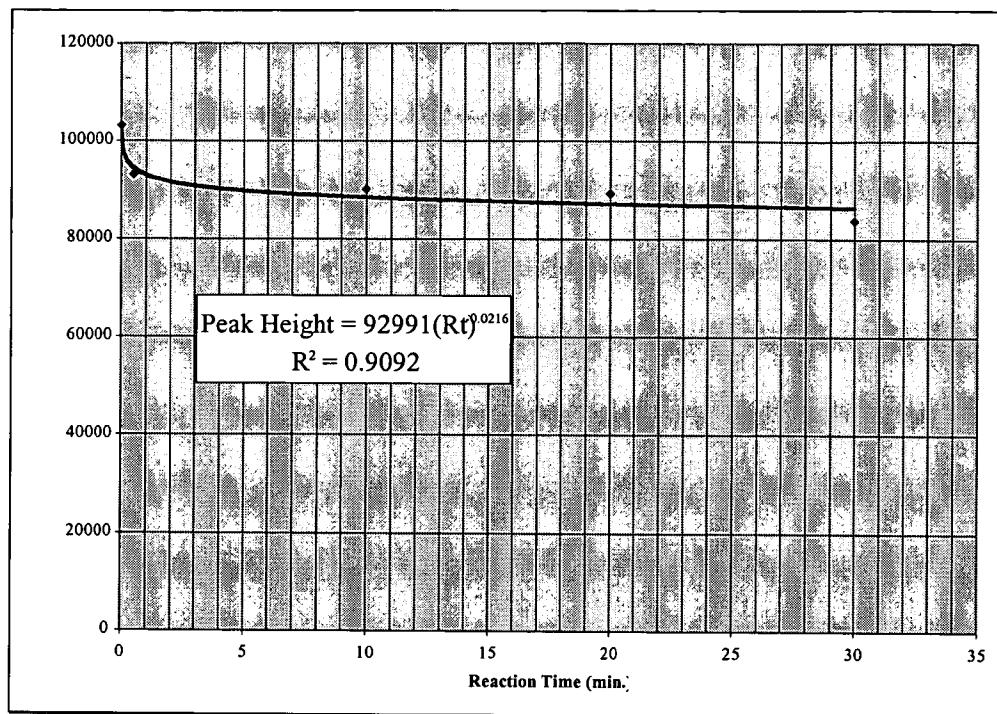


Figure 5: Kinetics of the Extraction of Butane by Lewcott

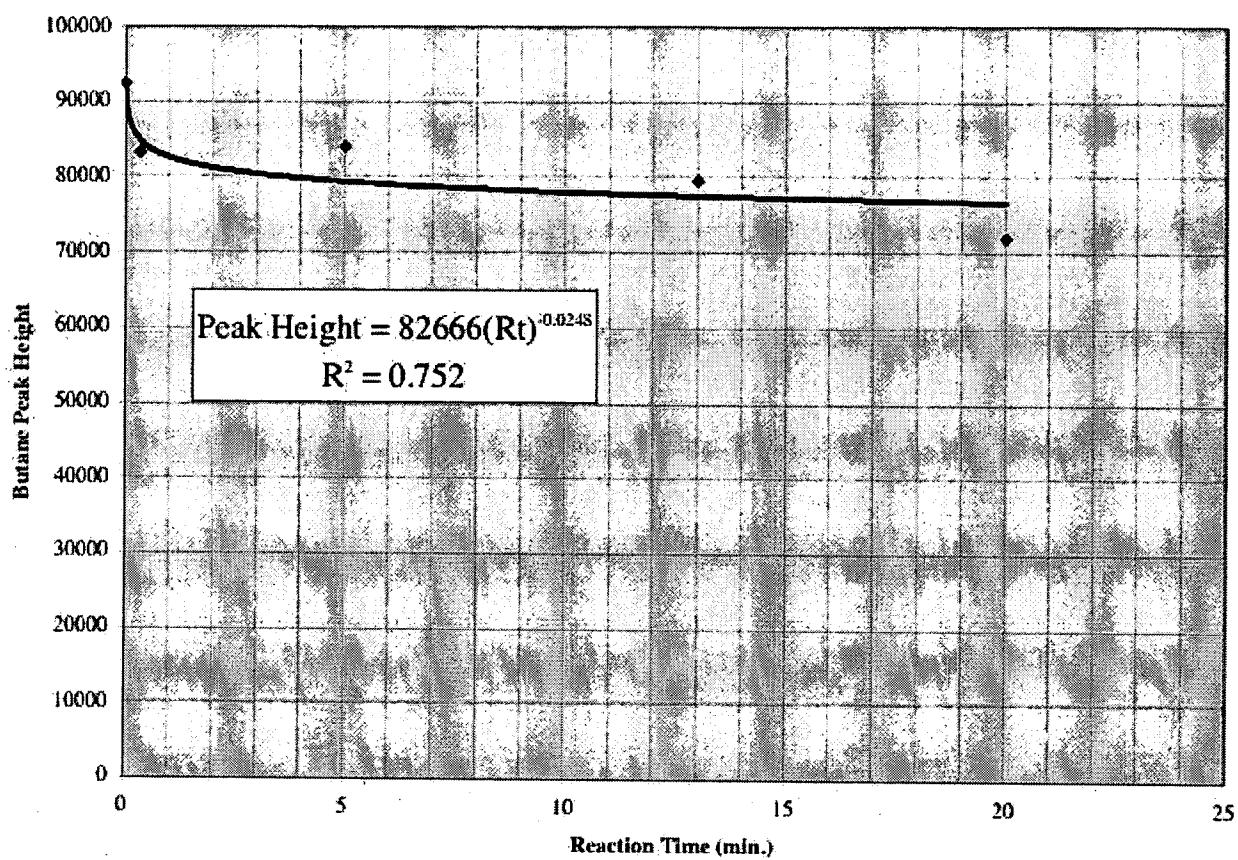


Figure 6 Kinetics of the Extraction of  
Butane by a PUR Reticulated Foam

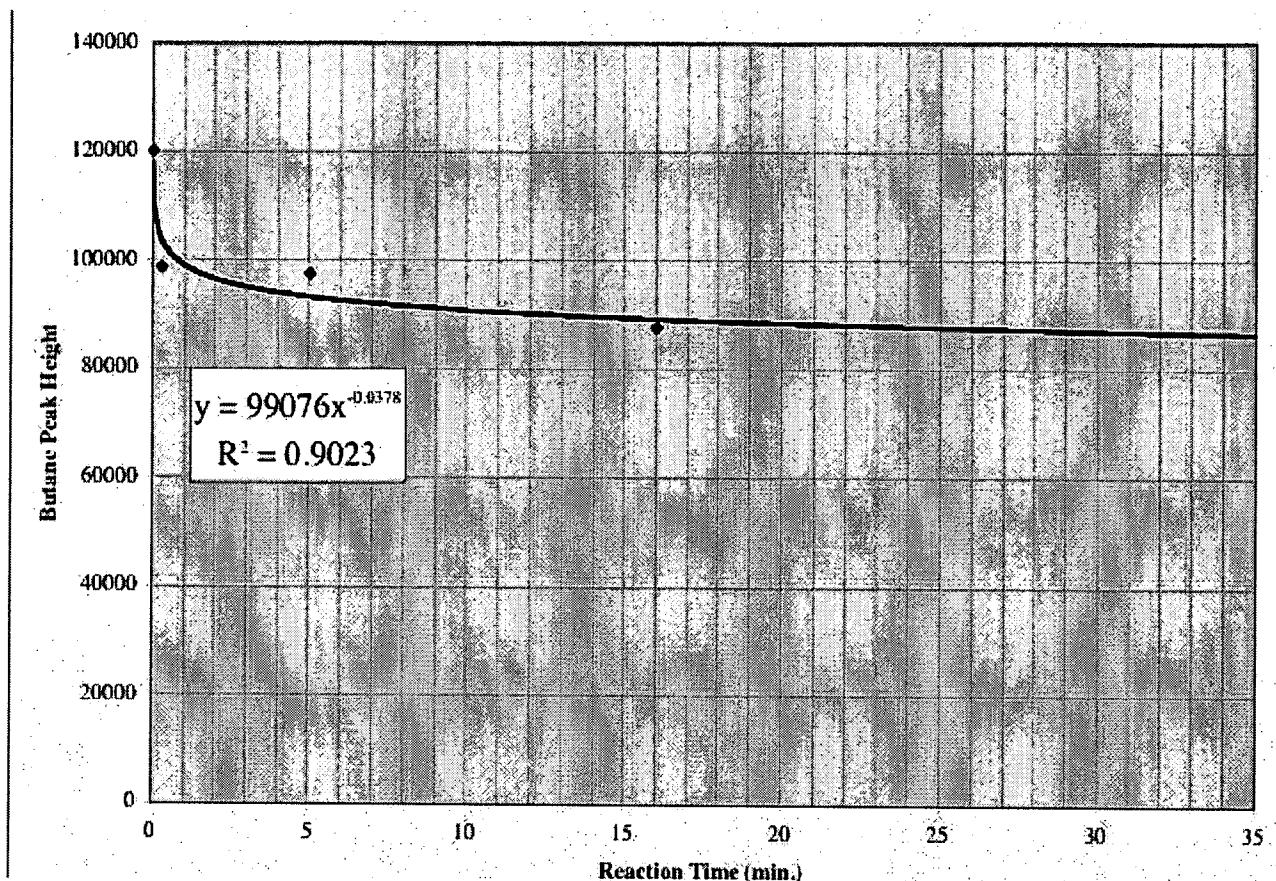


Figure 7 Kinetics of the Extraction of  
Butane by Native CoFoam

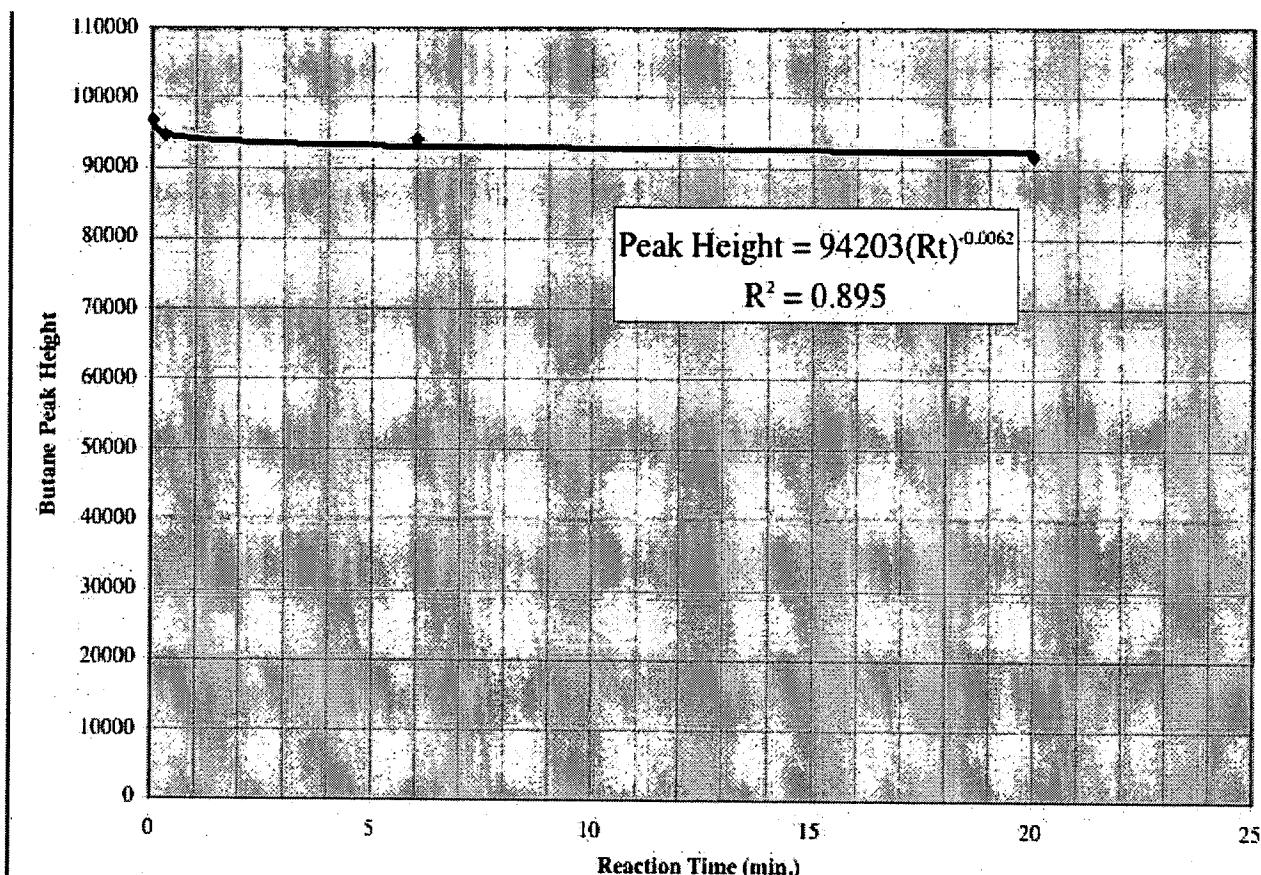


Figure 8: Kinetics of the Extraction of  
Butane by CoFoamII

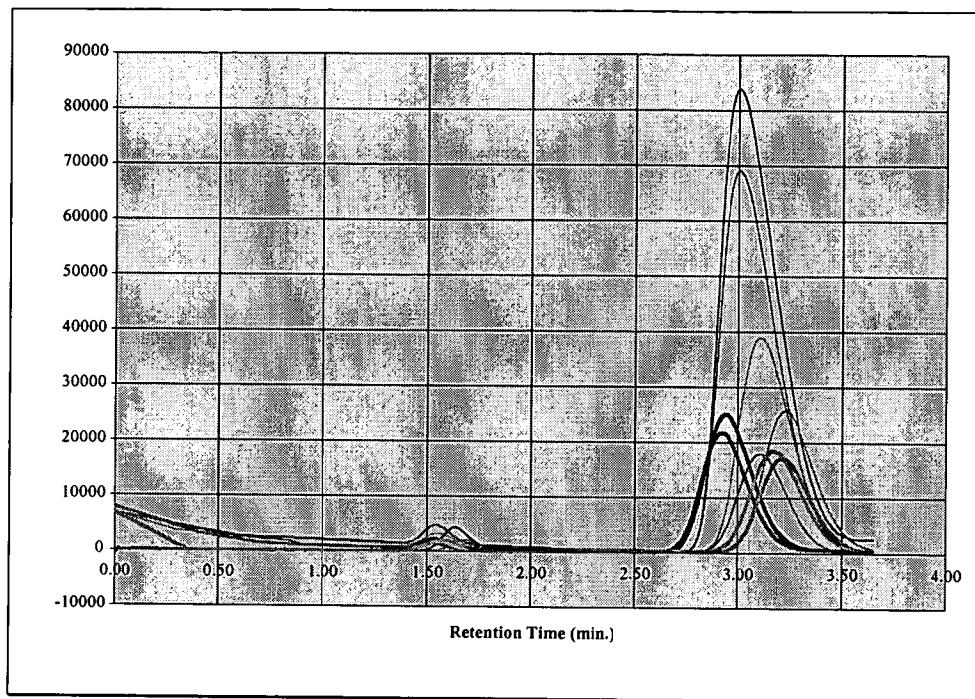


Figure 9: Chromatograms of the Extraction of Butane by Carbon-Impregnated CoFoam

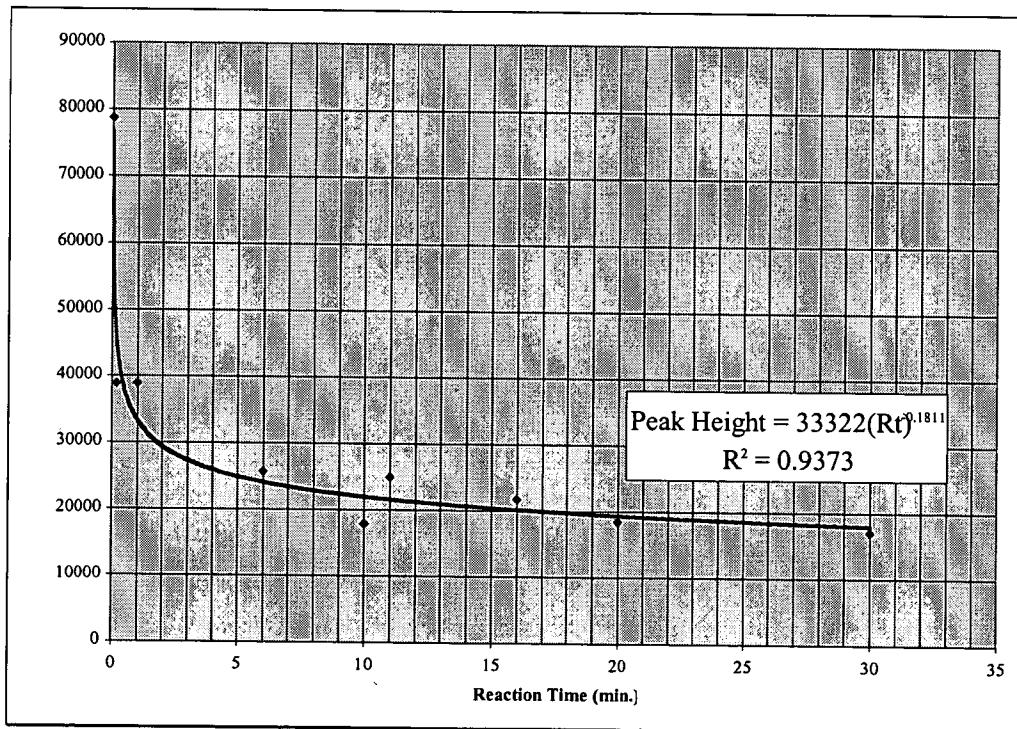


Figure 10: Kinetics of the Extraction of Butane by Carbon-Impregnated CoFoam

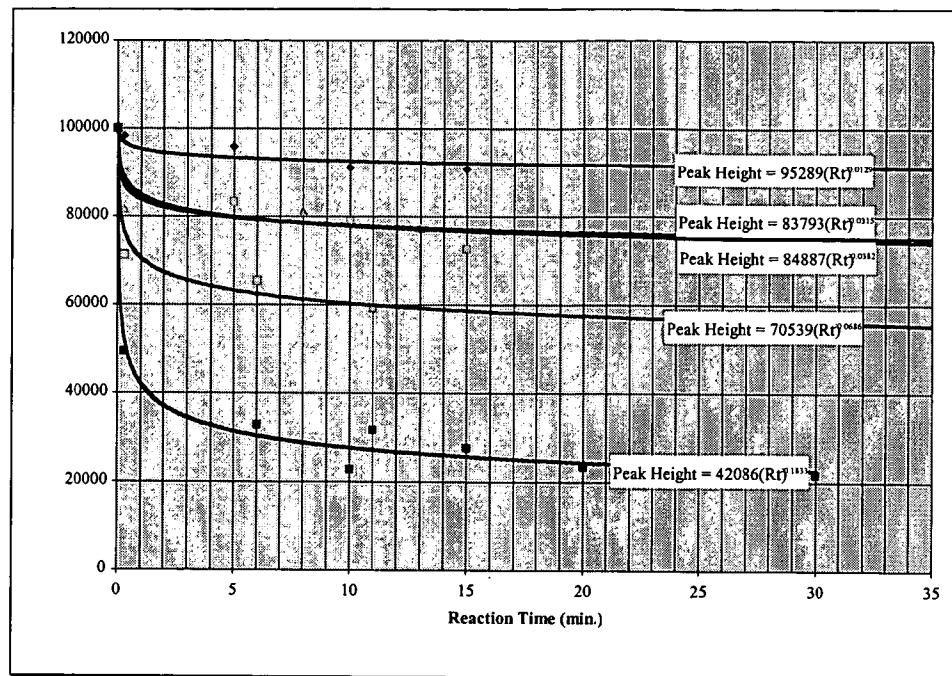


Figure 11: Extraction Kinetics as a Function of Carbon Concentration in CoFoam

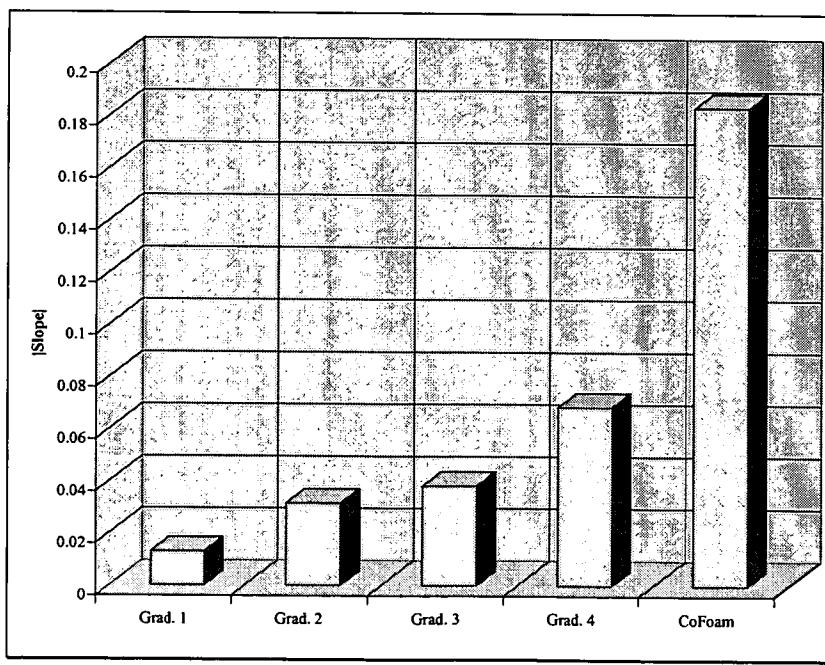


Figure 12: Slope of the Kinetics of Extraction by Carbon Concentration in CoFoam

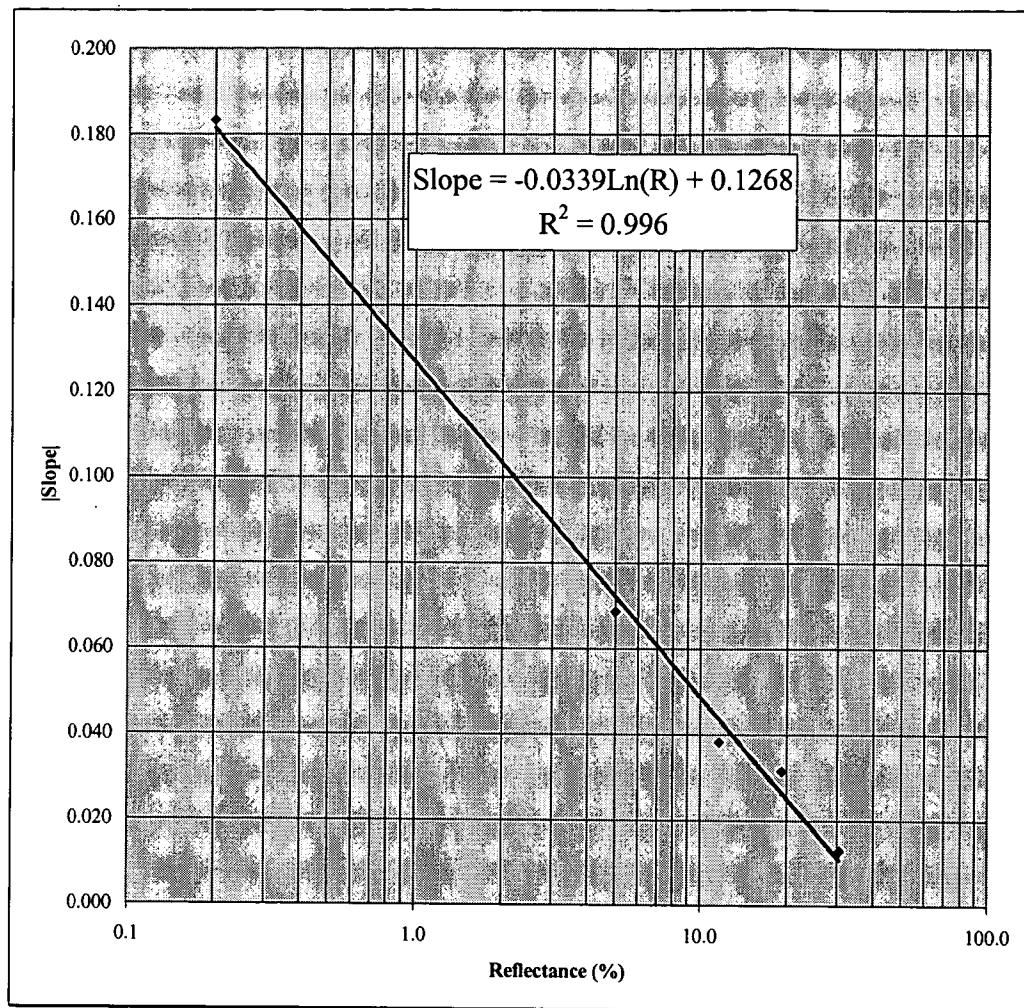


Figure 13: Slope of the Extraction Kinetics